Unit D Conclusion

Throughout Unit D you examined the importance of the environment in your life and explored many complicated issues. Environmental issues are frequently headline news. A balance may be hard to reach, but it is clear that you are directly affected by the environment around you and, in turn, have an effect on the surrounding environment. The choices you make often have unforeseen consequences.

A key theme in this unit has been the idea of stewardship. A steward protects and cares for the land but does not presume to own it—a steward's goal is to preserve environments for the future. This unit examined the living and non-living parts, cycles, natural changes, and diversity of Earth's environment. You also examined how you are part of the plants, animals, and ecosystems on this planet, and you studied how you can create both negative and positive change. A better understanding of Earth's living systems and the consequences of actions will help you make good choices so you can more effectively carry out a steward's role.

Career Profile

Forestry Development Officer

For Rebecca McKay, learning about forestry meant learning a special way to view trees. "Tree identification becomes second nature. Trees are not just things to analyze but, like people, they are things to understand and respect."

Rebecca's parents taught her to respect nature, and this, coupled with her love for the outdoors and in what goes on in forests, made her choice simple. "I wanted to work outdoors and felt at ease in the forest environment."

While still a student, Rebecca landed her first job in forestry. It was there that she saw all the options available to her in the field, so she made a commitment to stay in school. "Once I had my taste of forestry work and saw the number of options available, I knew I definitely wanted to continue my studies." She was drawn to the west coast "with its big trees and mountains," and entered the forestry program at the University of British Columbia in Vancouver. She graduated in 1998, something she feels is her greatest accomplishment in life so far. "I see it as a step toward the great things I will do."

At her first job after graduation, Rebecca was the only woman not doing clerical work. "I felt a bit intimidated at first, but I was given responsibilities like everyone else. I felt like I should make sure there was no doubt in their minds that a woman was capable of working with the best of them." Since then, she has held a number of jobs in forestry, including her first office-based job at the National Aboriginal Forestry Association (NAFA) in Ottawa.

She likes forestry because it allows her a wide range of possibilities and the ability to travel. "I worked internationally for two years, initially working on a CIDA internship in Guatemala, studying cloud forest composition and reforestation options." Now back home in Manitoba, Rebecca is currently a Forestry Development Officer with the province, focusing on policy development and implementation. "I work within the Sustainable Forestry Unit, which has the mandate to encourage Aboriginal forestry developments, including resource management, business ownership, and economic development."

Rebecca says that there is a great need for Aboriginal forestry professionals "to assist their communities in management. Not to prepare for this responsibility is to lose out on an opportunity for great economic gains. It is important to remember that Native values are vital to the practice of forestry and other sciences. Aboriginal foresters and other professionals can represent the interests and values of their communities to regain control of land resources."

As for schooling, Rebecca admits it sometimes seems a little insignificant. "It is hard to imagine that a difficult science or math class is going to do anyone any good, least of all on a bright sunny day. But it is one of many very important steps, small and large, on the path to making a difference. As insignificant as they may seem, these little days are the only way that the big days will go well. Try putting a roof on a brick house without using any bricks, and you will know what I mean. Enjoy the little accomplishments, because they are no less important and a lot more frequent."

Unit D Review Questions

1. Complete the table by comparing the processes of primary and secondary succession.

Description	Primary Succession	Secondary Succession
relative speed of process		
starting conditions		
events causing process to begin		
resulting community		

2. Match each definition with its correct term from the following list.

a. the total number of certain species that occupies a particular habitat at a particular time

b. a distinctive shape of a graph for a population that is increasing and growing exponentially

c. the amount of time it takes for a population to double in size

d. a group of organisms that exists in a natural setting where births, deaths, immigration, and emigration all affect population numbers

e. a rapid rise in population caused by ever increasing numbers

f. the maximum number of individuals sustained for an indefinite period in a given environment

g. a group of organisms existing in an artificial setting where immigration and emigration are not permitted and numbers are only affected by births and deaths

h. a distinctive shape of a graph for population limited by factors such as disease, competition, and famine

- doubling time
- exponential growth
- J-curve
- closed population
- open population
- carrying capacity
- S-curve
- population

3. Complete the following table of adaptations.

Type of Adaptation	How It Makes Organism More Successful	Example of Organism with Adaptation
speed	easier to catch prey and escape predators	cheetah or pronghorn
camouflage		
bright colours		
sharp spines		
produces poison		
thick fur or hair		
horns or antlers		

4. Complete this table by filling in the contributions that each scientist/researcher has made to the field of biology.

Researcher	Scientific Contribution
Malthus	
Lamarck	
Darwin	

5. Match each statement with its correct term in the following list.

a. This takes place because more organisms are produced than can survive and only the organisms that are best suited to the environment survive to reproduce.

b. This idea is that the nature of a population gradually changes form over geological time.

c. Human-directed change is caused in a population as a result of breeding organisms that only have characteristics desirable to the breeder.

d. This produces identical offspring, called clones, from a single parent cell without first sharing genetic information with another organism.

e. The reproductive success of an organism is not a measure of an individual's strength, speed, or health, although this may influence it.

f. This is a change in the genetic instructions.

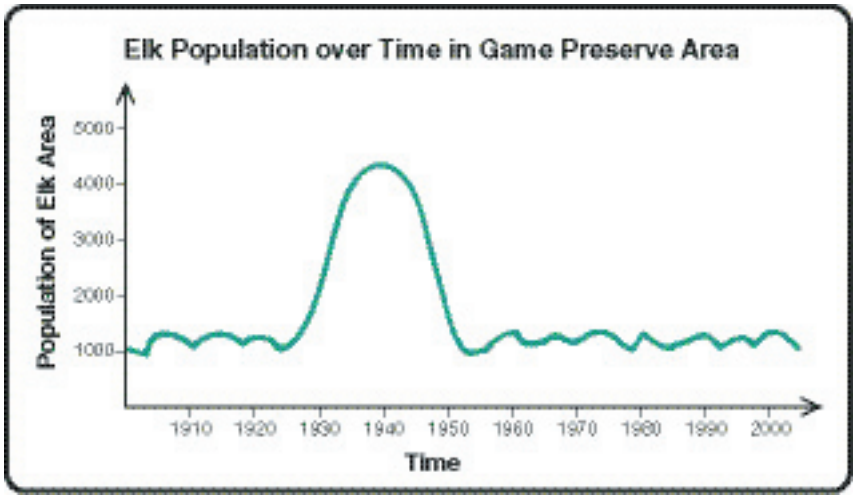
g. This basic unit of inheritance is passed down from parent to offspring.

- theory of evolution
- theory of natural selection
- fitness
- selective breeding
- gene
- mutation
- asexual reproduction

6. Close to where you live, a strip mine was started 100 years ago. The miners removed all the soil and exposed the raw bedrock as they removed the mineral ore. The soil and much of the broken rock were trucked away to be used for construction materials. The miners worked progressively outward from a central point over a period of 50 years to create a huge, bare, circular area. Imagine that you visit the site and make some observations. Make a sketch to show the following.

a. What type of organisms would you expect to find at the centre, or oldest, part of the mine?
b. What type of organisms would you expect to find at the outer edges, or youngest part, of the mine?
c. What type of organisms would you find in the surrounding area that was not mined?

Use the following information to answer questions 7 to 10.



Predators like wolves, cougars, and coyotes lived in the area with the elk until it was made into a game preserve in 1925. After 1925, the area was fenced in and predators inside the preserve were completely eliminated through hunting.

7. What effect did the predators have on the elk population prior to 1925?
8. Predict what happened to the elk population after 1925 when the area was fenced in and predators were removed.
9. As illustrated in the graph, state one possible reason for the elk population's decline after 1945.
10. Infer what action the park biologists could have taken in 1955 to re-establish a more natural balance to the elk population.

Use the following information to answer question 11.

Hot Adaptations

Deserts and other arid regions are difficult habitats to live in because water is so scarce. Deserts can be extremely hot in the day, but because there is little water to absorb and hold the heat, they can also be freezing cold at night.

Desert animals must conserve water and cannot afford to sweat to cool themselves because it would waste too much water—instead, they have developed other adaptations. Many animals sleep in cool burrows during the day and are active only in the mornings and evenings when the temperature is moderate. Desert creatures are usually small with short fur or thin fur and large ears or wrinkles to give them an increased surface area from which to lose heat.

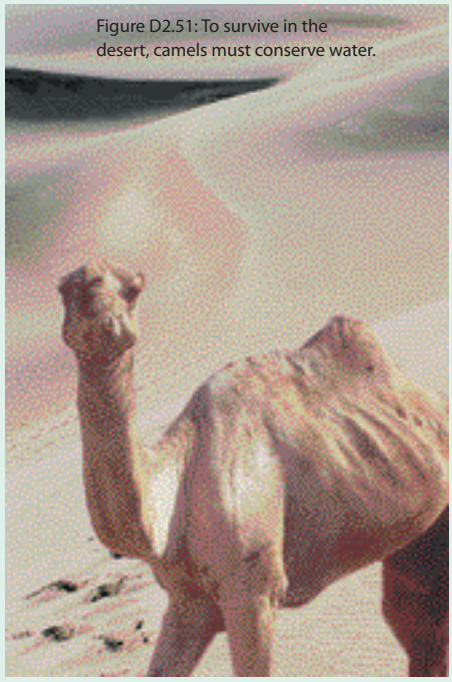


Figure D2.51: To survive in the desert, camels must conserve water.

11. A camel is an example of an organism that is perfectly adapted to the desert. How do the following camel adaptations help it to survive in the desert environment? Complete the table.

Adaptation	Reasons for Advantage
two sets of long eyelashes	
wide, padded feet	
nostrils that can open and close	
a hump located on its back that is a reservoir for fat	
thick, tan-coloured fur	
a tough mouth and strong teeth	

12. Hypothesize why so many plants that first colonize in open areas of secondary succession might have sharp thorns, barbs (like thistles or stinging nettles), or a noxious taste.
13. Some scientists predict that as human populations grow, freshwater resources will become an increasingly important export for Alberta. A pipeline to move this water could be built that would run directly from Alberta to dry cities in the United States, such as Los Angeles and Las Vegas. Justify the concerns you have regarding the possible export of fresh water from Alberta to the United States.

Use the following information to answer questions 14 to 21.

A biologist is studying the habitat of a small, isolated Arctic island. The island has populations of carnivorous Arctic foxes, a herbivorous bird called a ptarmigan, and a few insects in the summer. Because of the extreme wind, this island is much colder than the mainland. The only vegetation that grows well are small shrubs, lichens, and grasses.

Figure D2.52: On this island, ptarmigans are herbivores and Arctic foxes are carnivores.

14. List the abiotic factors that may affect survival on the island.

15. List the island's biotic factors.

16. Describe a relationship that may exist on the island.

17. Sketch a likely food chain for the island.

18. Sketch a likely energy pyramid.

19. Explain why the Arctic fox is white/grey.

20. Suppose hunters kill island Arctic foxes to the point of extinction for their valuable, thick, white pelts. How would this affect the population of remaining island species?

21. A hunter's campfire gets out of control and burns a large section of vegetation on the island.

a. What form of succession would take place following the fire?

b. How does fire affect the carbon cycle?

Use the following information to answer questions 22 to 28.

A recent study suggests a link between global warming and the predator-prey relationship of the Canadian lynx and the snowshoe hare. Scientists found that the fluffy snow from cold winters causes the lynx to sink into the snow, while the hare can escape more easily with this type of snow. Warmer winters melt and thin the snow. This provides an advantage for the lynx. Potential changes in the ecosystem's climate due to global warming may affect normal cycles of the predator-prey relationship between the lynx and hare. The main herbivore in the ecosystem is the snowshoe hare. The lynx feeds almost exclusively on the hare.

22. How would a reduction of the hare population affect the lynx population?

23. How would a reduction of the hare population affect other ecosystem populations?

24. Other than predation by the lynx, what other factors may affect the hare population size?

25. Sketch the population change for the hare if the lynx population is decimated by disease.

26. The snowshoe hare's fur colour changes from white in the winter to brown in the spring and summer.

- **a.** What is the advantage of this change?
- **b.** Use the theory of natural selection to describe how the hare developed two fur colours.

27. The global warming that benefits the lynx is linked to excessive amounts of carbon dioxide being released into the atmosphere. Relate three activities that add carbon dioxide to the atmosphere.

28. Global warming has also caused hot, dry summers with several resulting forest fires. A biologist was surprised to see that the numbers of both hares and lynxes were greater in these burned-out areas a few years after the fires than they were in thick stands of coniferous trees.

- **a.** Explain why hare and lynx numbers would be higher in these recently burned-out areas.
- **b.** Predict the implications of human intervention that prevents future forest fires in the area.

Use the following information to answer questions 29 to 31.

> A particular weed has been infesting crops in nearby fields. The weed has also spread into pastures and natural meadows, where it has had a negative effect on the native plants and animals. You are asked to conduct a field study to better understand this weed and the conditions that support its growth.

29. Infer specific tests you will want to carry out to determine what abiotic factors affect the weed's survival.

30. Design an experiment in which you change one of the abiotic factors identified in question 29. Determine the impact of this change on the weed's growth.

- **a.** List the manipulated, responding, and controlled variables.
- **b.** Describe the procedure.
- **c.** Predict the expected results. Explain why you expect these results.

31. A herbicide manufacturer studied the effectiveness of four of his herbicide spray products in terms of killing the weed. A crop was divided into five equal sections. Four of these sections was each sprayed with one type of herbicide.

- **a.** Why was the fifth section not sprayed?
- **b.** What is the manipulated variable for this experiment?
- **c.** What is the responding variable?
- **d.** List three controlled variables that would ensure accurate results.

32. Mosquitoes can be so annoying that it's tempting to wish they could somehow be completely eliminated from the environment. Comment on the possible negative consequences of removing mosquitoes from the biosphere.

Use the following information to answer questions 33 to 38.

The Biosphere II project was a huge contained-dome structure built in the Arizona desert. It was designed to simulate the processes of a natural ecosystem. More than 3800 species of plants and animals, including four male and four female scientists, were sealed in and meant to live there for one year. The scientists sealed inside were to study the interactions in the artificial environment that they built. In this closed system, all materials were to be recycled and no outside materials were to be brought in.

Figure D2.53: The Biosphere II project ended up as a failure.

Despite careful planning and monitoring, carbon-dioxide levels inside the dome continually increased and air had to be pumped in before two months had elapsed. The failure of the project demonstrated a lack of a complete scientific understanding of ecosystems.

Imagine that you have been hired as a consultant to help design an improved self-contained habitat for humans to live off Planet Earth, on an orbiting space station, or on another planet like Mars.

33. Identify essential organisms you would add to the environment, along with the people living there. Explain why you chose these essential organisms.

34. Sketch a food web for the organisms you selected.

35. Describe several important considerations you would incorporate into the habitat's design.

36. Explain how you would ensure that levels of carbon, oxygen, nitrogen, water, and wastes were maintained at appropriate levels.

37. If the populations in your biosphere are isolated for a long period, how might this affect them from an evolutionary point of view?

38. People already have a self-contained habitat on Earth.

- **a.** How is your artificial environment similar to Earth?
- **b.** How is your artificial environment different from Earth?
- **c.** Given the challenges involved in creating a second habitat for humans, what does this suggest about people's stewardship of their current habitat?